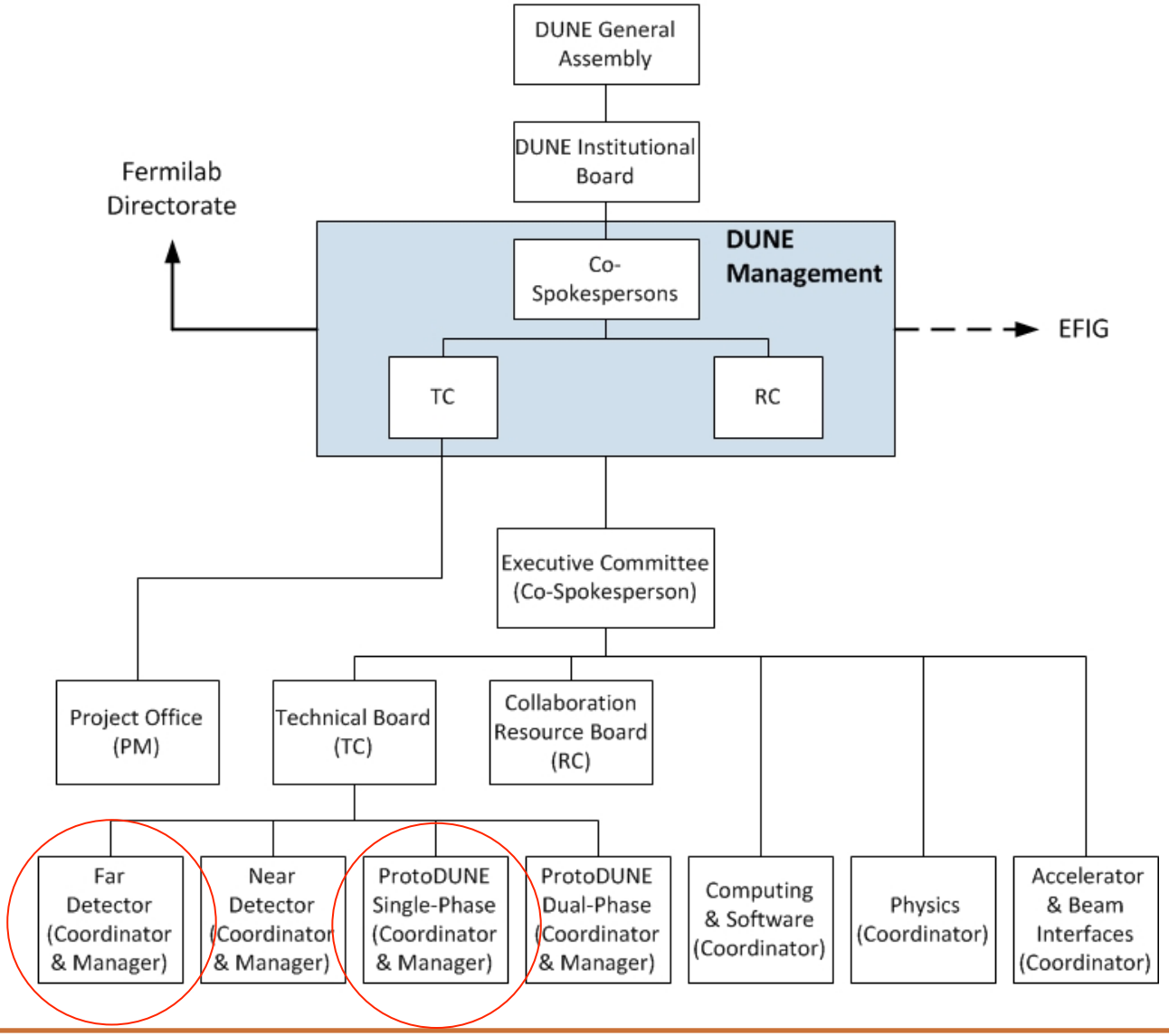
ProtoDUNE Planning

Eric James

35-ton Review

June 3, 2016

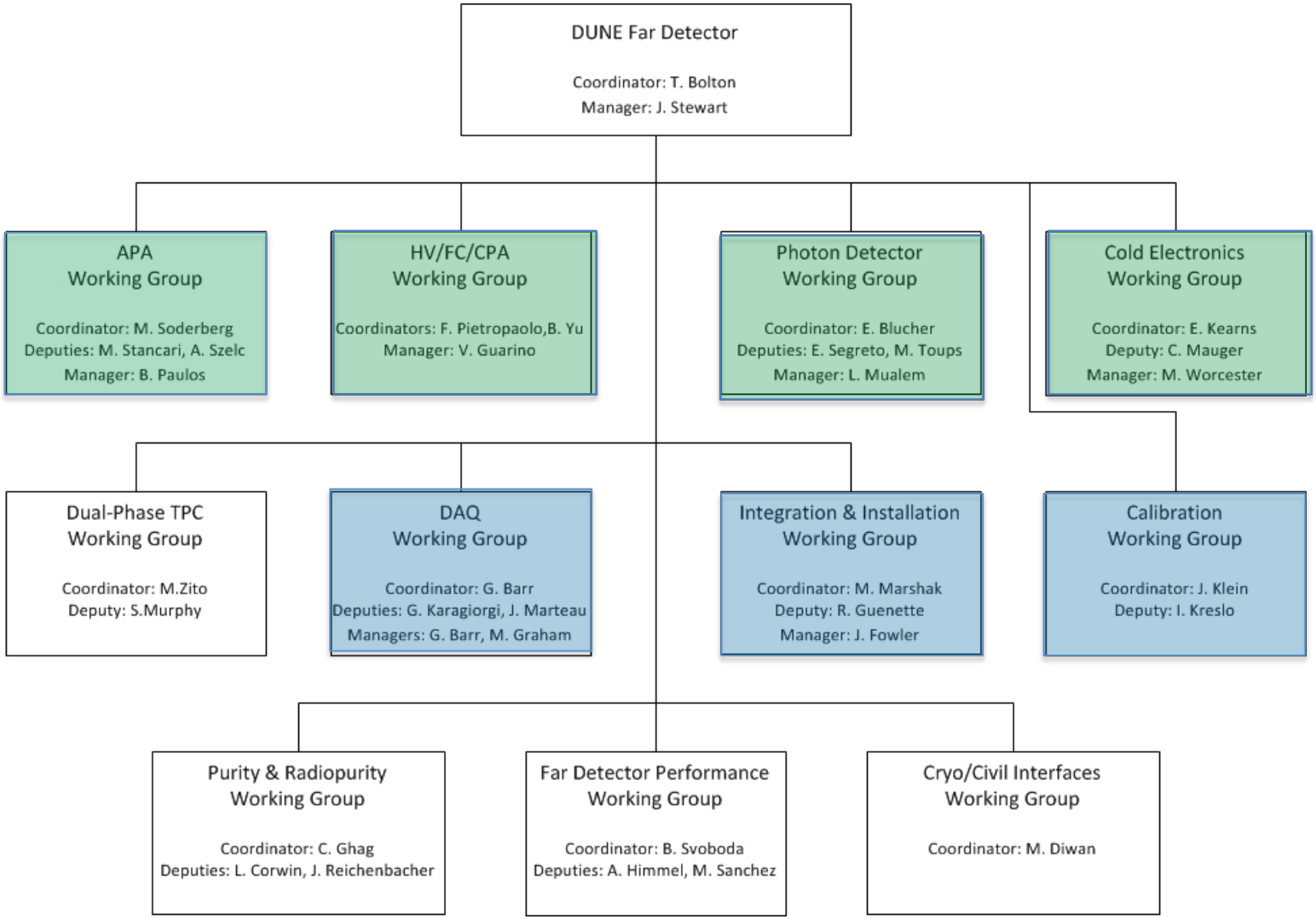
DUNE Collaboration Management



Responsibilities for ProtoDUNE-SP

- Far Detector Organization
  - Responsible for the design and fabrication of the full-scale prototype detector components (for the first 10-kton far detector module) from which the ProtoDUNE-SP detector is constructed
- ProtoDUNE-SP Organization
  - Responsible for all activities on the ground at CERN needed to integrate, install, commission, and operate the detector
  - Includes fabrication of “special” detector components needed for operating the detector in a beam and on the surface at CERN
  - Interfaces to DUNE Physics and Software & Computing Organizations

Roles of Far Detector Working Groups in ProtoDUNE-SP



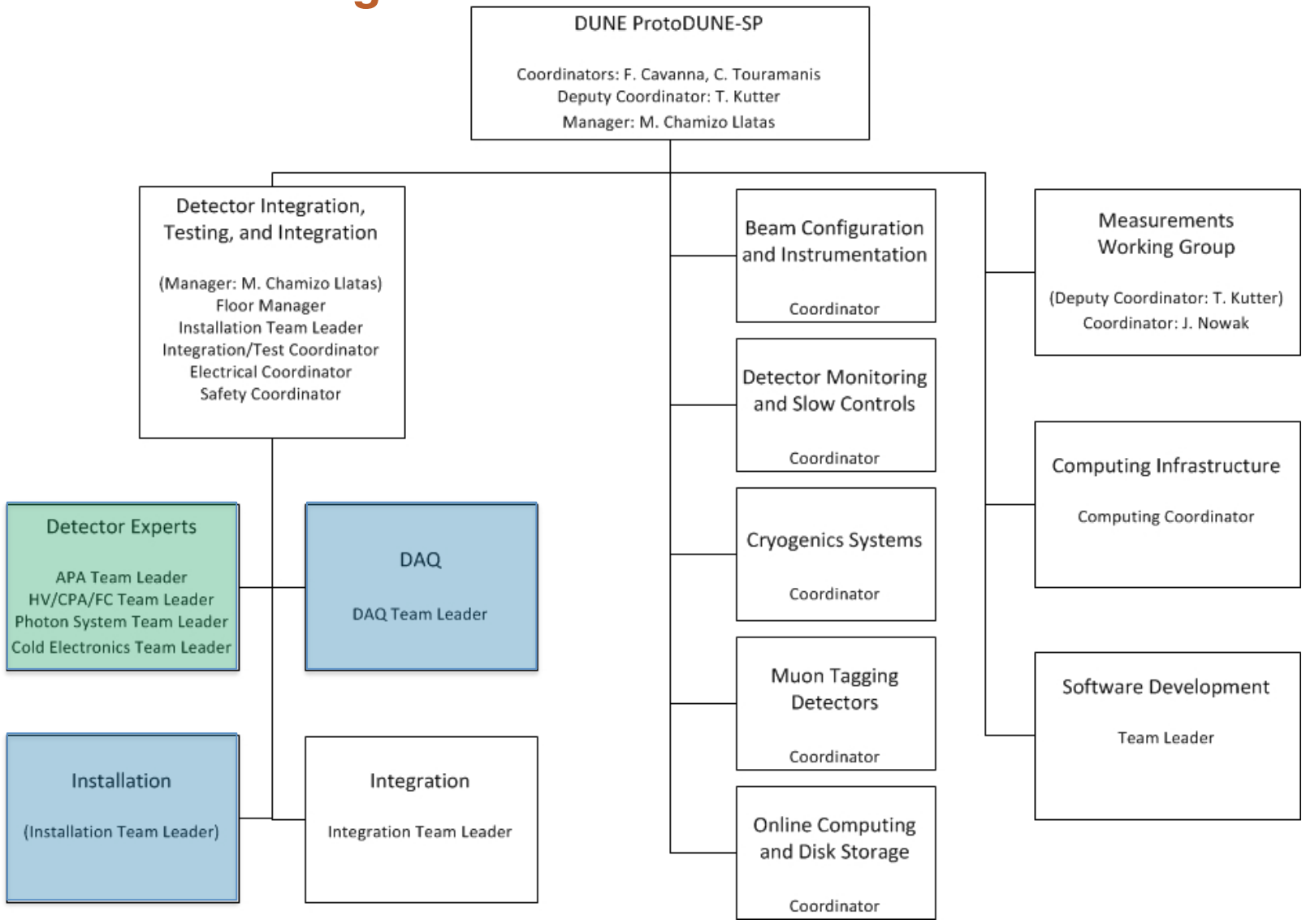
Group 1 (APA, HV/FC/CPA, Photon Detector, Cold Electronics)

- Direct responsibility for production of ProtoDUNE-SP detector components
- Responsible in coordination with ProtoDUNE-SP management team for identifying system experts among the contributing institutes who will be resident at CERN in 2017-2018 to carry out the integration, testing, installation, and commissioning
- A coordinator will be selected from this team who will report directly to ProtoDUNE-SP management and be responsible for planning and directing the needed activities at CERN

Group 2 (DAQ, Installation, Calibration)

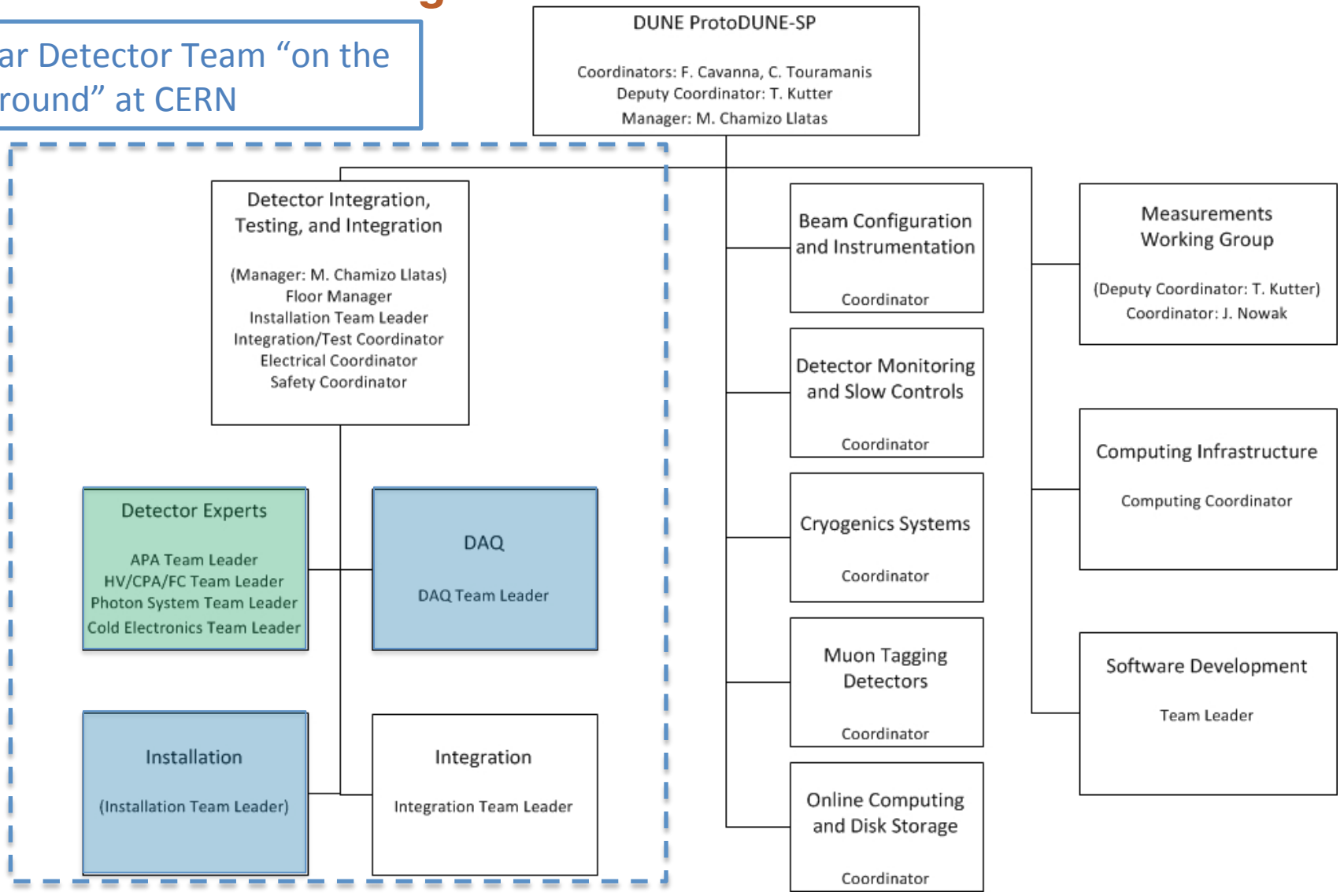
- Support role for ProtoDUNE-SP
- Primary responsibility for these systems/activities held by ProtoDUNE-SP management team
- ProtoDUNE-SP management team will form teams (not working groups) with leaders on the ground at CERN to implement these systems/activities
- It is expected that there will be a large overlap between the membership of the ProtoDUNE-SP team and the corresponding far detector working group

ProtoDUNE-SP Organization



ProtoDUNE-SP Organization

Far Detector Team "on the ground" at CERN



Fermilab DUNE

Required Team at CERN

DUNE Personnel at CERN for protoDUNE-SP Integration/Installation/Commissioing/Data Taking

	2017												2018											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Managers																								
protoDUNE-SP manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Floor Manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
Installation coordinator (Jack)			1	1	1	1	1	1	1	1	1	1												
Integration/Test Coordinator					1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Computing Coordinator	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Electrical Coordinator	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
Safety Coordinator	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Detector Experts																								
TPC				2	2	4	4	4	4	4	4	4	2	2	2	2	2	1	1	1	1	1	1	0
TPC HV												2	2	2	2	2	2	2	2	2	2	2	2	0
PD				1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
Electronics (cold and warm)	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
DAQ	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1
Trigger				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DQM	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Beam Detectors					1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
Cosmic Muon Tracker*					2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0
Calibration*					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
Computing expert	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slow Control Monitoring	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cryogenics	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
General Assistants																								
Technitians	4	4	4	4	4	4	4	4	4	4	4	4	1	1	1	1	1	1	1	1	1	1	1	1
Run Coordinators (3)																	3	3	3	3	3	3	3	3
Total	21	21	22	26	34	36	36	36	36	36	36	38	32	32	32	32	34	32	31	31	31	31	31	19

	2017	2018	Total
Total personnel at CERN (person-months)	378	368	746

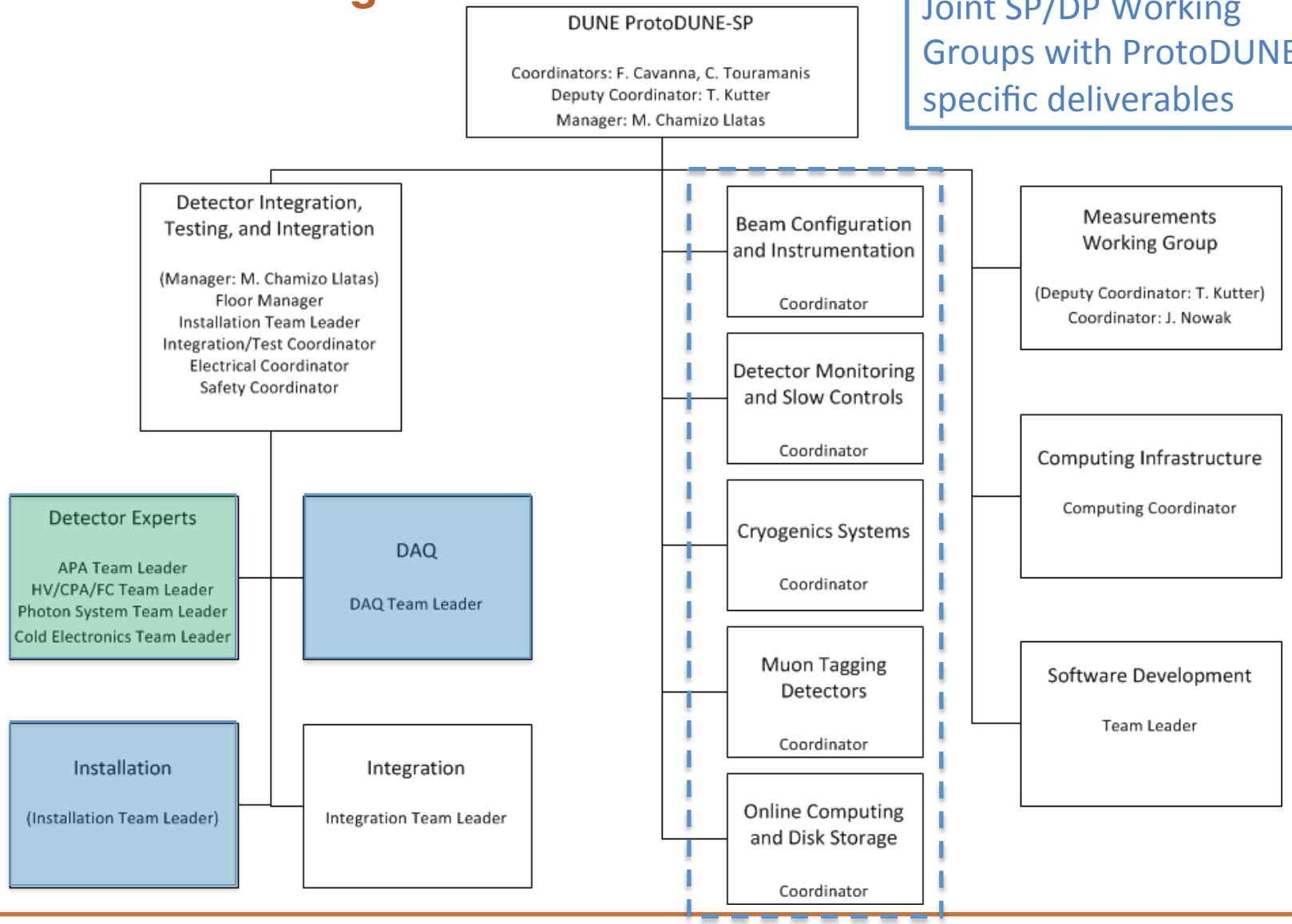
Fermilab DUNE

ProtoDUNE Operations Fund

- Fermilab Directorate and DOE charged DUNE management with producing a proposal for a U.S. operations budget for the ProtoDUNE detectors
- Proposal based on U.S. CMS/ATLAS operations programs
- Outlines funds needed for travel and housing expenses of U.S. personnel required at CERN for operating the detectors, detector consumables such as cryogens, and offline computing needs (not covered by project)
- Fermilab directorate working with DOE to secure funding for FY17 and FY18

ProtoDUNE-SP Organization

Joint SP/DP Working Groups with ProtoDUNE-specific deliverables



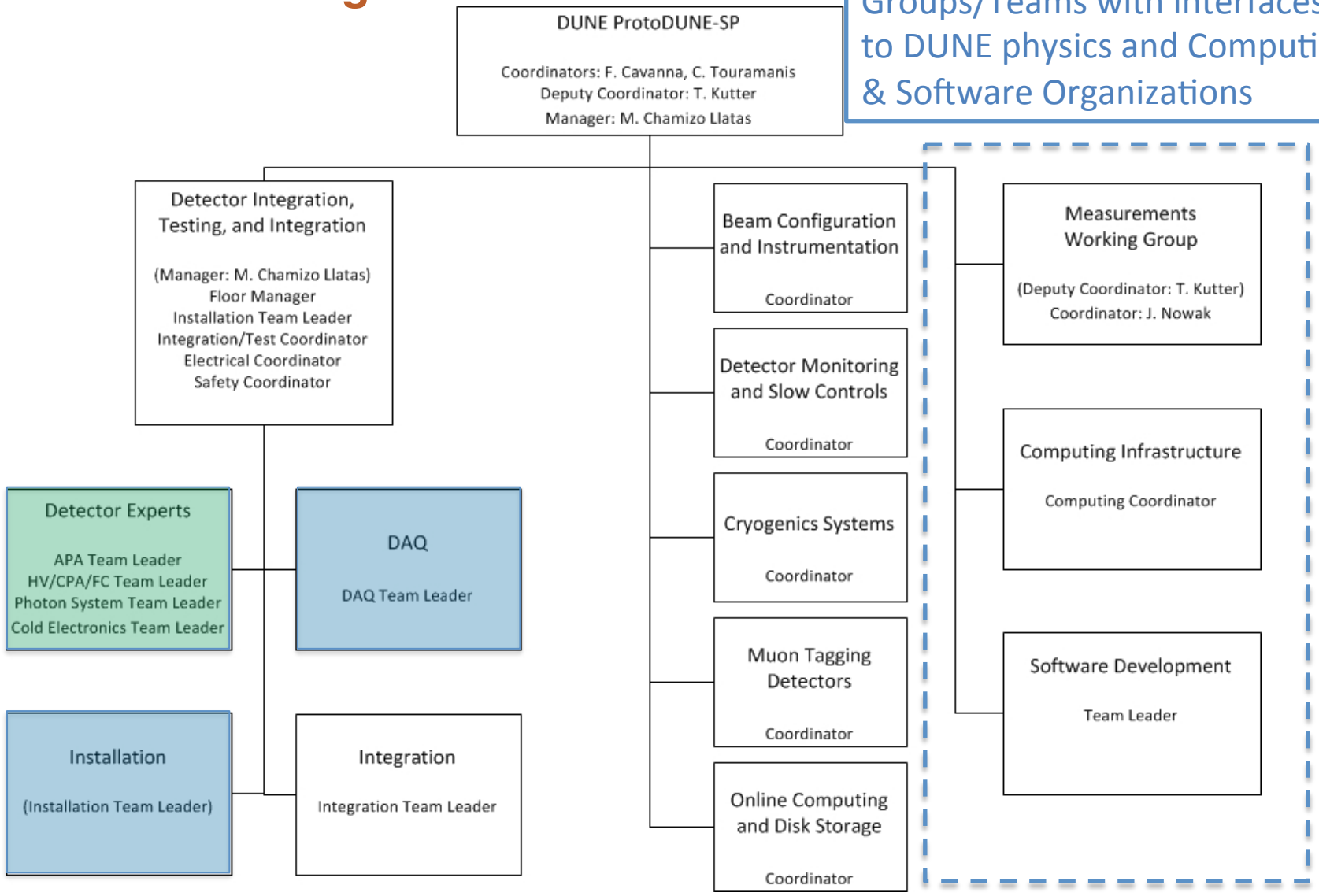
Fermilab DUNE

New ProtoDUNE-SP working groups

- Many of these are expected to be joint ProtoDUNE-SP and ProtoDUNE-DP efforts
- Currently envision …
  - Beam configuration and instrumentation
  - Detector monitoring and slow controls
  - Cryogenic systems (including internal cryostat piping)
  - Muon tagging detectors
  - Online Computing and Disk Storage
- These groups also serve as the interface point with the associated neutrino platform activities

ProtoDUNE-SP Organization

Groups/Teams with interfaces to DUNE physics and Computing & Software Organizations



ProtoDUNE-SP MOU

	CORE COST [kCHF]	DOE or non-CERN Partner (%)	CERN (%)	Institutions Expressing Interest (*)
Cathode Plane Assemblies	350	50%	50 %	BNL, CERN, Princeton
Anode Plane Assemblies	910	100%		BNL, Lancaster, Liverpool, Manchester, Sheffield, STFC-DL, Wisconsin
Field cage	480	75%	25%	BNL, CERN, Stony Brook
Cold Readout Electronics	810	100%		BNL, Fermilab, Pennsylvania, SMU
200 kV supply and feed-through	380	100%		ETHZ, UCLA
Signal feed-throughs	450	50%	50%	BNL, CERN
Photon Detectors	380	100%		Campinas, CSU, Hawaii, Indiana, LSU
Photon Detector Electronics	430	100%		ANL
Electronics Infrastructure	340	100%		Fermilab
DAQ	550	70%	30%	CERN, Cambridge, Liverpool, Oxford, SLAC, STFC-DL, Sussex, Warwick
Detector Installation	650	60%	40%	CERN, Duke, Minnesota, Oxford
Online data processing	490	70%	30%	BNL, CERN, Fermilab
Detector slow control	350	70%	30%	CERN, Fermilab
Cryostat Support Structure	650		100%	CERN
Membrane Cryostat	3'200		100%	CERN
Cryostat Beam Windows	300	100%		LBNL
Cryogenics plant	940	40%	60%	CERN, Fermilab
Purity monitors	90	100%		
Clean Room	390		100%	CERN
Total [kCHF]	**12'140**	**6'139**	**6'001**	

Financial Commitments to ProtoDUNE-SP

- CERN is making a major contribution to the effort primarily through detector infrastructure but also incorporating some contributions to the detector itself
- U.S. project assumes responsibility for all remaining detector components while actively pursuing additional international contributions
- Within the past week, we have received official notice that the U.K. will fund construction of 3/6 APA modules along with some DAQ components

EOI process

- To meet the need for additional resources to successfully implement the ProtoDUNE program, a call for “Expressions of Interest” from DUNE collaboration institutes was made at the January 2016 collaboration meeting
- Response has been very positive (over 60 collaboration institutes have submitted EOIs covering all identified ProtoDUNE-SP subsystems)
- DUNE working group leaders are responsible for bringing together the interested institutes to discuss the formation of the institutional consortia who will take responsibility for the various detector subsystems

EOI Results for ProtoDUNE-SP

Description	QTY Institute EOIs
NP04-A APA Planes	12
NP04-B CPA Planes	8
NP04-C HV Distribution	5
NP04-D Field Cages	8
NP04-E Ground Planes	5
NP04-F Cold ASIC chips	6
NP04-G Cold Motherboards	9
NP04-H APA Readout Cables	2
NP04-I Photon Detectors	16
NP04-J PD Readout Cables	3
NP04-K Cryostat Flanges	3
NP04-L Warm APA readout electronics	7
NP04-M PD readout electronics	9
NP04-N Rack Infrastructure	2
NP04-O Back-end DAQ computing	11
NP04-P Run Control Software	2
NP04-Q Slow Controls & Monitoring	5
NP04-R Cryogenic Interfaces & Purity Monitors	2
NP04-S Beam Windows & Beam Interfaces	3
NP04-T TPC Calibration System	9
NP04-U PD Calibration System	4
NP04-V Cosmic Veto System	8
NP04-W Computing Infrastructure	7
NP04-X Detector Installation	9
NP04-Y Detector Integration	9
Unspecified	1

EOI Results for ProtoDUNE-SP

NP04-A APA Planes
- Argonne National Laboratory
- Brookhaven National Laboratory
- College of William and Mary
- Lawrence Berkeley National Laboratory
- SLAC National Accelerator Laboratory
- Syracuse University
- The DUNE-UK Collaboration
- University of Campinas - UNICAMP
- University of Pittsburgh
- University of Texas Arlington
- University of Wisconsin
- Yale University

NP04-B CPA Planes
- Argonne National Laboratory
- Brookhaven National Laboratory
- CERN
- College of William and Mary
- Stony Brook University
- Syracuse University
- University of Pittsburgh
- University of Texas Arlington

NP04-C HV Distribution
- Brookhaven National Laboratory
- Czech Republic Institutes
- Louisiana State University
- University of Houston
- Yale University

NP04-D Field Cages
- CERN
- Brookhaven National Laboratory
- College of William and Mary
- Kansas State University
- Louisiana State University
- Stony Brook University
- Syracuse University
- University of Campinas - UNICAMP

NP04-E Ground Planes
- CERN
- Brookhaven National Laboratory
- College of William and Mary
- Kansas State University
- Syracuse University

NP04-F Cold ASIC chips
- Boston University
- Brookhaven National Laboratory
- Lawrence Berkeley National Laboratory
- Michigan State University
- Pennsylvania
- Southern Methodist University

NP04-G Cold Motherboards
- Boston University
- Brookhaven National Laboratory
- Louisiana State University
- Michigan State University
- Pennsylvania
- SLAC National Accelerator Laboratory
- Southern Methodist University
- University of Pittsburgh
- University of Texas Arlington

NP04-H APA Readout Cables
- Brookhaven National Laboratory
- Michigan State University

NP04-I Photon Detectors
- Brookhaven National Laboratory
- Caltech
- College of William and Mary
- Colorado State
- Czech Republic Institutes
- Fermilab
- Indiana University
- Kyiv National University
- Louisiana State University
- Massachusetts Institute of Technology
- Northern Illinois University
- South Dakota School of Mines & Technology
- University of Campinas - UNICAMP
- University of Hawaii at Manoa
- University of Houston
- University of Wisconsin

NP04-J PD Readout Cables
- Argonne National Laboratory
- Brookhaven National Laboratory
- Czech Republic Institutes

NP04-K Cryostat Flanges
- CERN
- Brookhaven National Laboratory
- University of Campinas - UNICAMP

NP04-L Warm APA readout electronics
- Boston University
- Brookhaven National Laboratory
- Kansas State University
- Pennsylvania
- SLAC National Accelerator Laboratory
- University of California Davis
- University of Pittsburgh

NP04-M PD readout electronics
- Argonne National Laboratory
- Caltech
- College of William and Mary
- Czech Republic Institutes
- Fermilab
- Indiana University
- Massachusetts Institute of Technology
- University of Campinas - UNICAMP
- University of Texas Arlington

NP04-N Rack Infrastructure
- CERN
- Duke University

NP04-O Back-end DAQ computing
- CERN
- Brookhaven National Laboratory
- College of William and Mary
- IFIC (Valencia, Spain)
- Lawrence Berkeley National Laboratory
- Pacific Northwest National Laboratory
- SLAC National Accelerator Laboratory
- The DUNE-UK Collaboration
- University of California Davis
- University of Minnesota

NP04-P Run Control Software
- CERN
- Maryland

NP04-Q Slow Controls & Monitoring
- CERN
- IFIC (Valencia, Spain)
- Kansas State University
- Maryland
- The DUNE-UK Collaboration

NP04-R Cryogenic Interfaces & Purity Monitors
- Brookhaven National Laboratory
- University of Houston

NP04-S Beam Windows & Beam Interfaces
- CERN
- Duke University
- Lawrence Berkeley National Laboratory

NP04-T TPC Calibration System
- Czech Republic Institutes
- Kyiv National University
- Pennsylvania
- Southern Methodist University
- University of Bern
- University of Campinas - UNICAMP
- University of Hawaii at Manoa
- University of Pittsburgh
- University of Wisconsin

NP04-U PD Calibration System
- Argonne National Laboratory
- Indiana University
- University of Campinas - UNICAMP
- University of Hawaii at Manoa

NP04-V Cosmic Veto System
- Czech Republic Institutes
- Louisiana State University
- Northern Illinois University
- Pennsylvania
- Southern Methodist University
- University of Bern
- University of Campinas - UNICAMP
- University of Wisconsin

NP04-W Computing Infrastructure
- Argonne National Laboratory
- Brookhaven National Laboratory
- CERN
- Lawrence Berkeley National Laboratory
- University of Houston
- University of Texas Arlington

NP04-X Detector Installation
- CERN
- Brookhaven National Laboratory
- Duke University
- Lawrence Berkeley National Laboratory
- Louisiana State University
- University of Campinas - UNICAMP
- University of Houston
- University of Minnesota
- University of Wisconsin

NP04-Y Detector Integration
- CERN
- Brookhaven National Laboratory
- Duke University
- Lawrence Berkeley National Laboratory
- SLAC National Accelerator Laboratory
- University of Campinas - UNICAMP
- University of Houston
- University of Minnesota
- University of Wisconsin

Unspecified
- Fermilab Scientific Computing Division
- UFABC (Brazil)

Process

- Working group coordinators contact institutions expressing interest in their areas
- Organization of open meetings/workshops to discuss formation of institutional consortia
- Written proposals for institutional responsibilities to each subsystem are reviewed by DUNE Technical Board
  - Resources for subsystem construction (Far Detector Mgmt.)
  - Resources for subsystem installation/commissioning (ProtoDUNE-SP Mgmt.)
- Follow-up from project management team

Technical Board Reviews

- Review of proposal for full-scale HV testing at Fermilab (May 20th)
- Review of proposal for institutional contributions to photon detection fabrication, testing, installation, and commissioning (May 31st)
- Review of proposal for activities related to trial assembly of full-scale TPC components at Ash River (May 31st)
- Review of proposal for institutional contributions to cold electronics fabrication, testing, installation, and commissioning (June 14th)
- Review of proposal for integrated noise testing at Fermilab (June 14th)
- Review of proposal for institutional responsibilities to DAQ system fabrication, testing, installation, and commissioning (June 28th)
- Review of proposal for institutional responsibilities to online computing & online disk storage (June 28th)

Technical Board Reviews

- Review of proposal for institutional responsibilities to field cages, cathode planes, and HV system fabrication, testing, installation, and commissioning (July)
- Review of proposal for institutional responsibilities to APA fabrication, testing, installation, and commissioning (July)
- Review of proposals for ProtoDUNE specific subsystems (July)

Finalizing EOI Process

- EOI process has already resulted in many new institutions becoming involved in ProtoDUNE activities
- Goal is to assign final responsibilities for all ProtoDUNE-SP detector components on the timescale of late June
  - Allows time to incorporate potential new interest from non-U.S. institutes originating from European and Latin American meetings held in April
- Working group leaders are charged with reporting back on the status of communications with all institutes submitting EOIs in their areas of responsibilities to ensure that none of the submitted EOIs “fall through the cracks”

ProtoDUNE-SP Reviews

- Establishing review process for ProtoDUNE-SP detector components and have embedded review milestones within the updated schedule
- DUNE Technical Board will review conceptual designs for detector components that have significantly evolved since last summer's CD-1R DOE review
- After collaboration approval of the conceptual designs, the project will be responsible for conducting design and production readiness reviews for all components (incorporating external reviewers)

ProtoDUNE-SP Design Review Schedule

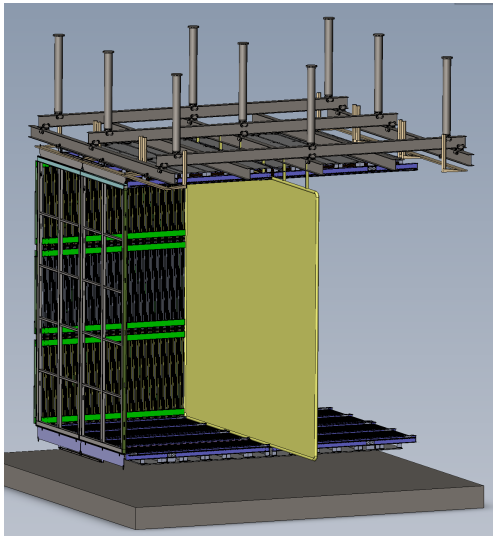
Subsystem	Design Review	Production Readiness Review
APA	July 13-14 2016	January 2017
CPA, Field Cage	October 2016	February 2017
DAQ	September 2016	February 2017
Photon Detector	August 2-3 2016	October 2016
Cold Electronics	November 2016	February 2017
TPC DSS	with APA	with APA
Installation	with components	March 2017

Planned ProtoDUNE-SP TPC Integration Testing

- Mechanical trial assembly of prototype TPC components at Ash River in Fall 2016
- HV testing of full-scale TPC Components at Fermilab (Winter 2017)

Mechanical Trial Assembly (Ash River)

- Install final quadrant of TCP using a minimum of these proto-type parts:
  - 1 APA frame (not strung)
  - 2 CPA
  - Top and Bottom Field Cage (both sides
  - End Wall Field Cage
- Structure is designed to support 2 quadrants of APA,CPA and FC
- Help develop final sequencing and test assembly procedures, access equipment and any required lifting fixtures
- Be prepared for installation at CERN, including trained supervisors & techs



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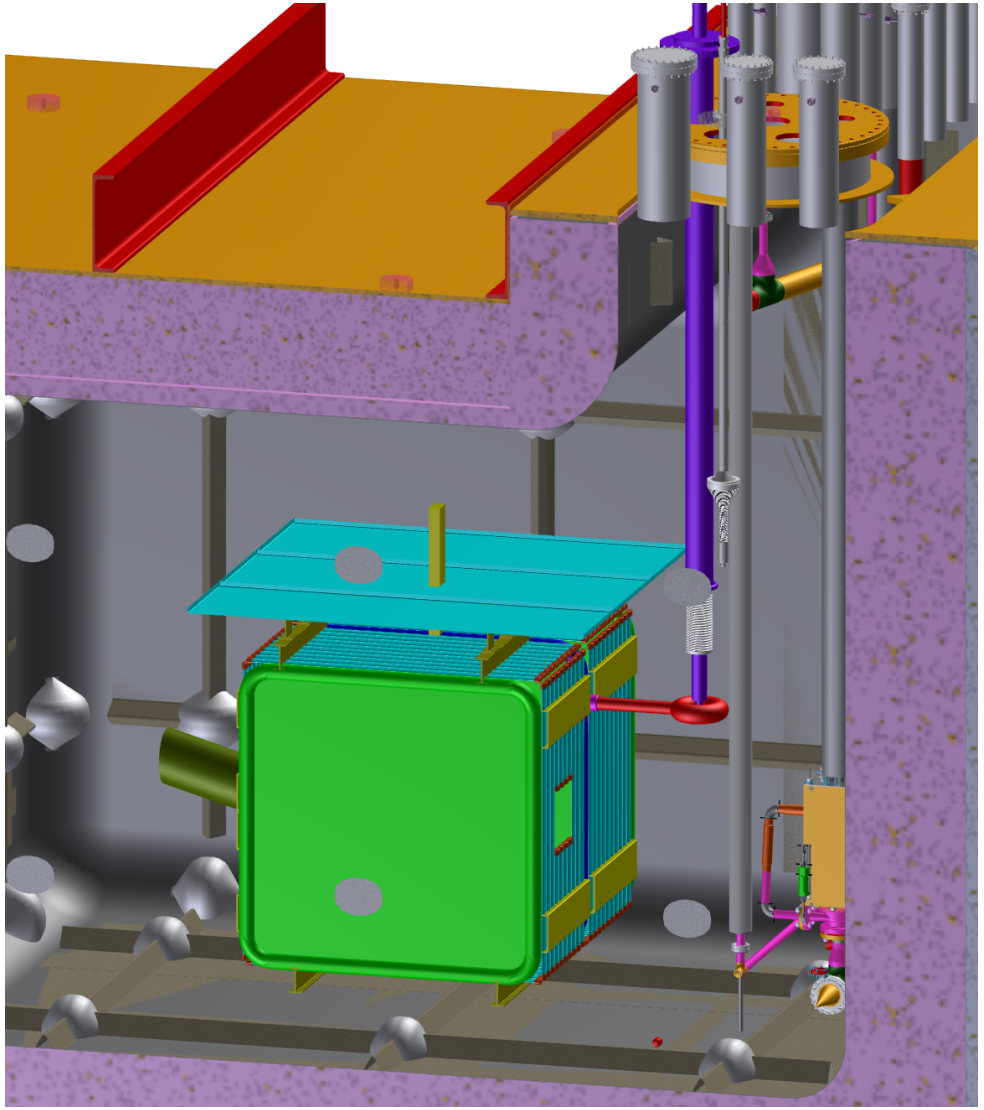
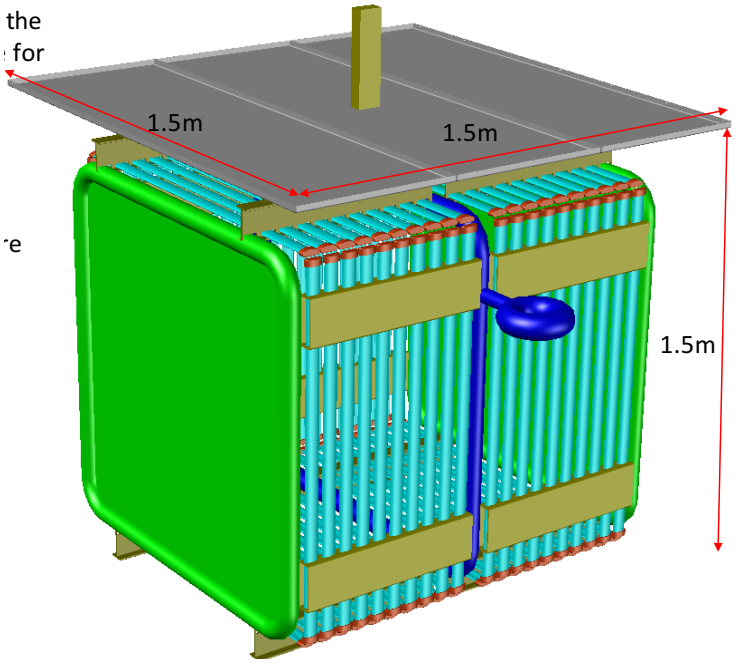
HV Testing (35-ton Cryostat)

- Test full-size field-cage, CPA, and HV components in purified liquid argon
- Test beam plug designed to displace liquid argon in region where beam enters the cryostat
- Opportunity for further cryogenics development

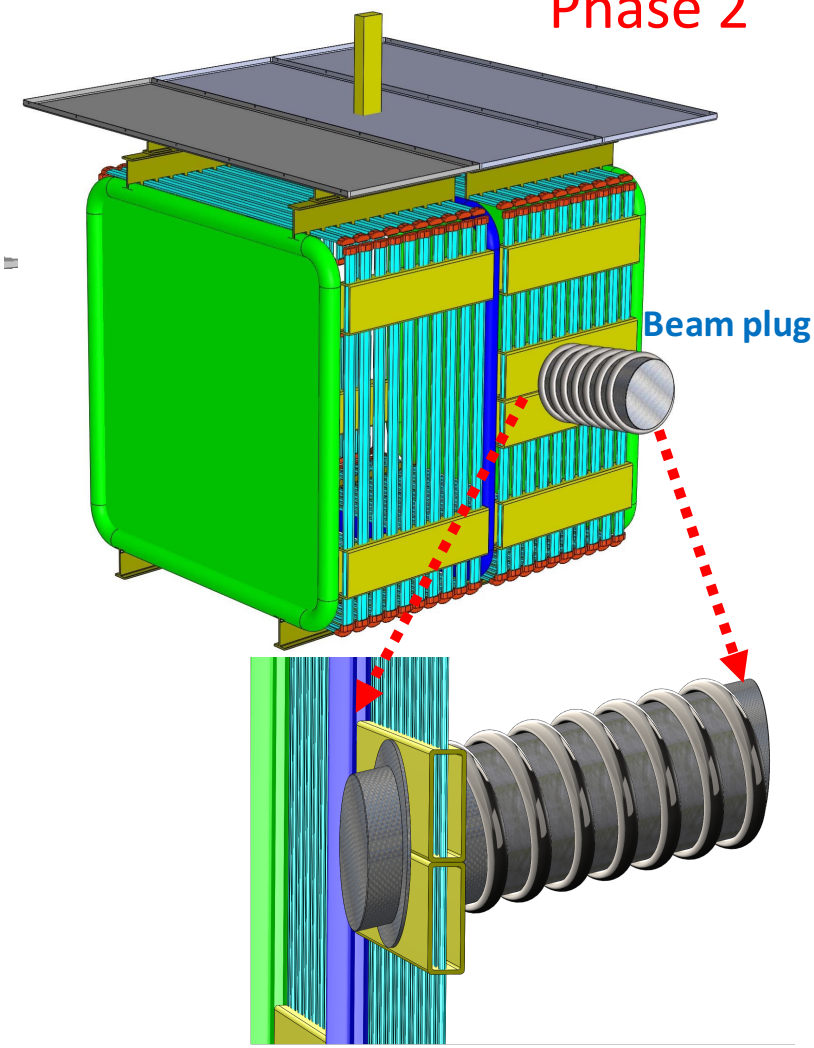


HV Testing (35-ton Cryostat)



Phase 1

Phase 2



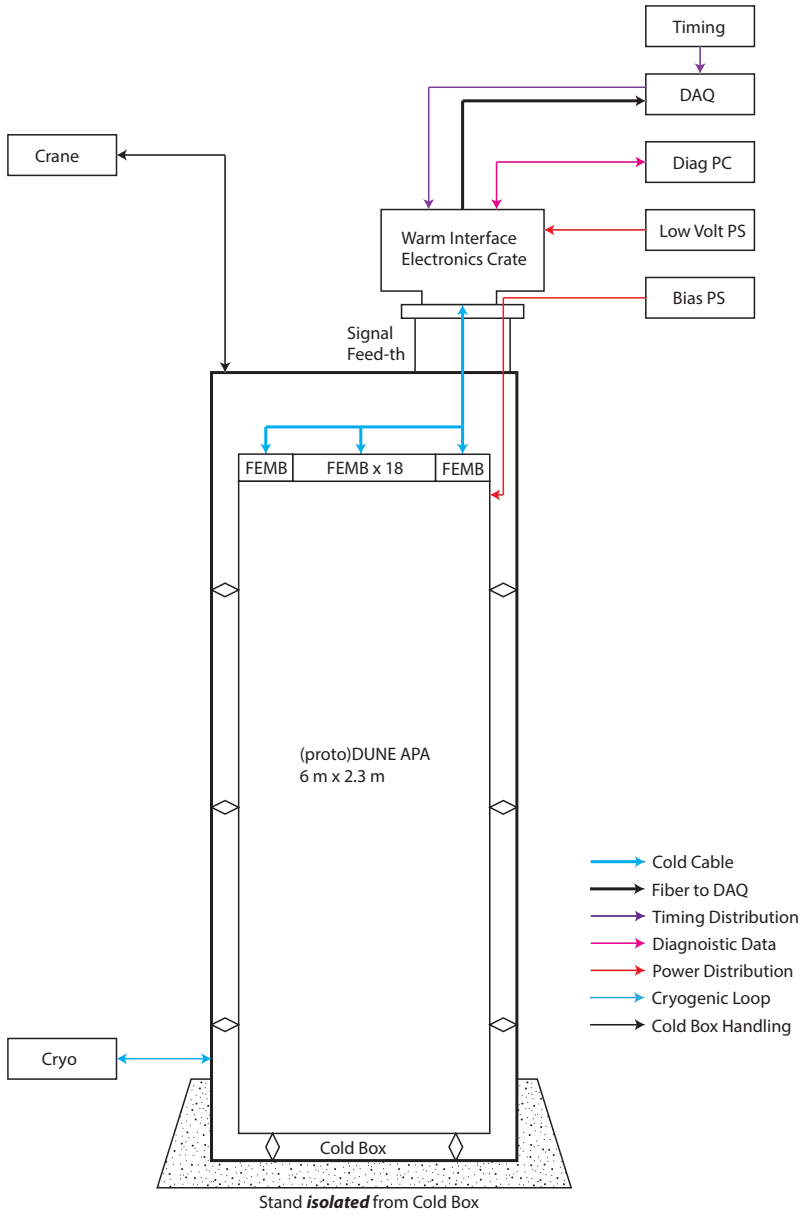
Planned ProtoDUNE-SP Electronics Integration Testing

- In-situ cold and warm testing of 35-ton components to understand origin of observed noise and study mitigations
- Integrated noise test stands at Fermilab and BNL to validate new components in a realistic working environment (e.g. reading out chamber situated in a Faraday-shielded room)
- Integration testing of final APA units connected to the real DAQ system in the experimental area at CERN (anticipated to be done in cold and in Faraday-shielded environment)

Final Integration Testing (CERN)

- Final integration testing of completely integrated APA outside of cryostat prior to installation in cryostat

- In cold, in Faraday-shielded environment attached to real DAQ system



Final Integration Testing (CERN)